

WHAT IS CLAIMED IS:

- 5 1. A piston type pumping apparatus, comprising:
 - a vertically oriented cylinder having a top and a bottom, the bottom having a first aperture;
- 10 a first passageway for liquid in the cylinder at the top thereof;
- 15 a second passageway for liquid in the cylinder at the below thereof;
 - a piston reciprocatingly mounted within the cylinder and having an area against which pressurized fluid acts in the direction of movement of the piston;
- 20 a hollow piston rod connected to the piston and extending below the piston and slidably and sealingly through the first aperture in the bottom of the cylinder;
 - a reload chamber below the cylinder, the piston rod extending slidably and sealingly into the reload chamber and having a third passageway for liquid communicating with the reload chamber, the piston rod having a smaller area within the reload chamber upon which pressurized fluid in the reload chamber acts in a direction of movement of the piston and piston rod compared to said area of the piston;
- 25 a first one-way valve located in the third passageway which permits liquid to flow from the reload chamber into and above the piston rod and prevents liquid from flowing back through the piston rod into the reload chamber;
- 30 a fourth passageway for liquid extending from the reload chamber to a source of

liquid to be pumped;

5 a second one-way valve in the fourth passageway which permits liquid to flow from the source of liquid into the reload chamber and prevents liquid from flowing from the reload chamber towards the source of liquid;

10 means for storing pressurized liquid connected to the second passageway for storing pressurized liquid displaced below the piston, as the piston moves downwardly, and to assist in raising the piston and, accordingly, liquid contained within the piston rod, to pump liquid upwardly and through the first passageway, said means for storing including a body of liquid;

a pump connected to the body of liquid for pumping liquid into the cylinder below the piston to raise the piston;

15 a fifth passageway for liquid adjacent to the bottom of the cylinder;

a first conduit connecting the fifth passageway to the centrifugal pump; and

20 a second conduit connecting the second passageway to the body of liquid.

2. The apparatus of claim 1, wherein the body of liquid is a receiver.

3. The apparatus of claim 2, including a pressure release valve adjacent to the second 25 passageway in the second conduit.

4. A piston type pumping apparatus, comprising:

30 a vertically oriented cylinder having a top and a bottom, the bottom having a first aperture;

a first passageway for liquid in the cylinder at the top thereof;

a second passageway for liquid in the cylinder at the bottom thereof;

5 a piston reciprocatingly mounted within the cylinder and having an area against which pressurized fluid acts in the direction of movement of the piston, whereby the pressurized fluid raises the piston in the cylinder during a pumping stroke thereby forming a volume of fluid in the cylinder under the piston, and the piston acts on the volume of fluid thereunder during a recovery stroke;

10 means for pressurizing the volume of fluid during the recovery stroke, whereby the pressurized volume of fluid is potential energy that is later converted to kinetic energy to assist in raising the piston on subsequent pumping strokes;

15 means for storing pressurized liquid connected to the second passageway for storing pressurized liquid displaced from below piston

a hollow piston rod connected to the piston and extending below the piston and slidably and sealingly through the first aperture in the bottom of the cylinder;

20 a reload chamber below the cylinder, the piston rod extending slidably and sealingly into the reload chamber and having a third passageway for liquid communicating with the reload chamber, the piston rod having a smaller area within the reload chamber upon which pressurized fluid in the reload chamber acts in a direction of movement of the piston and piston rod compared to said area of the piston;

25 a first one-way valve located in the third passageway which permits liquid to flow from the reload chamber into and above the piston rod and prevents liquid from flowing back through the piston rod into the reload chamber;

a fourth passageway for liquid extending from the reload chamber to a source of liquid to be pumped;

5 a second one-way valve in the fourth passageway which permits liquid to flow from the source of liquid into the reload chamber and prevents liquid from flowing from the reload chamber towards the source of liquid;

the means for pressuring the volume of fluid includes a body of liquid;

10 a centrifugal pump connected to the body of liquid for pumping liquid into the cylinder below the piston to raise the piston; and

15 a fifth passageway for liquid adjacent to the bottom of the cylinder, a first conduit connecting the fifth passageway to the pump and a second conduit connecting the second passageway to the body of liquid.

5. The apparatus of claim 4, wherein the body of liquid is a receiver.

6. The apparatus of claim 5, including a pressure release valve adjacent to the second passageway in the second conduit.